Governor's Office of Energy Management and Conservation

Biomass

Information & Resources

Contents

Woody Biomass:

As used in the ***Healthy Forest Restoration Act*** (HR 1904), the term biomass means "trees and woody plants, including limbs, tops, needles, and other woody parts, and by-products of preventative treatment, such as wood, brush, thinnings, chips and slash, that are removed to reduce hazardous fuels or to reduce the risk of, or to contain, diseases or insects.

Frequently Asked Questions

Q *What is Biomass?*

A Biomass is any organic matter that is available on a renewable/sustainable basis for energy or products. Carbohydrates are the organic matter that make up biomass. They are formed through photosynthesis as sunlight converts CO2 and water into carbohydrates, including sugars, starches and cellulose.

Q *What are the primary sources of woody biomass?*

A Wood-processing residues (sawdust/trimmings/bark); In-forest residues (fuel treatments/thinnings); Woody agricultural residues and invasive woody species; and Urban wood wastes

Q *What is bioenergy?*

A Bioeneregy results from the use of organic matter (biomass) to produce heat, steam and to generate electricity from biofuels taken from forest-related or other sources.

Q *What are biofuels?*

A Biofuels are gaseous or liquid fuels such as ethanol or methanol, biodiesel and blended alcohols manufactured from biomass resources. Biofuels are produced using a variety of thermal, chemical and biological processes.

Q *What is cellulosic ethanol?*

A Currently, most ethanol comes from agricultural crops possessing considerable starches, such as corn or soy beans. Cellulosic ethanol is produced from woody biomass such as forest residues or small-diameter material. The process is not yet being done on a large commercial-scale basis.

Photo: Dan Bihn

Biomass Quick Facts

- Biomass currently supplies roughly 3% of the total energy consumption in the U.S.
- Approximately 75% of biomass consumption comes from forestlands (142 million dry tons). The remainder (48 million dry tons) comes from croplands.

- When biomass is converted to energy, there is no net increase in carbon dioxide (CO_2) since trees grow back and photosynthesize (absorb CO_2) to balance emissions.
- Biomass is a clean source of renewable energy compared to burning fossil fuels. Burning biomass is done under controlled conditions using efficient systems that reduce emissions associated with pollutants; some of which cause acid rain.
- Renewable energy makes up about 6% of the United States' energy consumption. Biomass comprises 47% of the renewable energy consumption. The complete energy consumption picture is as follows:
  - Natural Gas: 24%
  - Coal: 23%
  - Nuclear: 8%
  - Petroleum: 39%
  - Renewable Energy: 6%
    - Biomass: 47%
    - Hydroelectric: 45%
    - Geothermal: 5%
    - Wind: 2%
    - Solar: 1%

Forest Conditions…

Forest Management and Protection…

Forest Products and Wood Utilization…

Forest Condition

- ✓ Forest and Watershed Health
- ✓ Communities at Risk
- ✓ Forest Ecology
- ✓ Sustainability

SUSTAINABLE

Forest Products/ Marketing & Utilization

- ✓ Small Diameter M & U
  - Biomass/ Bioenergy
  - Market Development
  - Product Utilization

Forest Management

- ✓ Ecosystem Management
  - Forest Restoration
- ✓ Wildland-Urban Interface
  - Fuels Reduction
  - Community Protection

The Problem: Forest Condition

Impacts to Colorado forests during turn of the century settlement, followed by the regeneration of dense stands of trees and nearly 100 years of fire suppression, has resulted in overstocked forests which can yield catastrophic wildfire, insect and disease outbreaks and overall reduced forest health. These forests are outside their natural range of variability leading to:

- Watersheds and Communities at Risk
- Reduced Ecosystem Function & Structure
- Reduced Wildlife Habitat & Reduced plant diversity

The Results: Forest Products/Marketing & Wood Utilization

Colorado has a small traditional timber industry—primarily due to our low rainfall and rocky soil types. Most of the material being removed to meet forest restoration and fuels reduction objectives is considered small diameter (4–12 inch)

Products Currently Produced

- Small Saw Logs (flooring, pallets, dimensional lumber)
- Post and Poles/Landscape Timbers
- Specialty Products (furniture, mulch)

Opportunities for Increased Utilization

- Pellet Manufacturing
- Biomass for Facility Heating
- Reduced per-acre Treatment Costs as Biomass Gains Value

The Solutions: Forest Management & Protection (Stewardship, Restoration & Fuels Reduction)

By conducting science-based ecosystem management practices, forest condition can be altered and moved towards more natural, pre-European settlement conditions. Reducing forest density will allow fire to be reintroduced into forest ecosystems to mimic fire's natural and historic role. Tools being used to meet these objectives include:

- Adaptive Management
- Best Management Practices
- Stewardship Contracting
- Prescribed Fire
- Community Wildfire Protection Plans
- Ecosystem Management

Biomass Utilization Challenges and Key Issues

Challenges

- ***Consistent and Reliable Supply***—The gross supply of biomass material for a wide range of applications is clearly present. The uncertainty of a consistently offered and available source of biomass is a potential barrier to increased utilization
- ***Lack of Infrastructure***—The availability of reasonably low cost biomass depends in part on the presence of a local forest industry to collect, process and market wood products. This can consist of small-diameter markets and products but must be in place to help with the use of the material being thinned and removed.
- ***Transportation Costs***—Transporting low-value material from the forest to local road networks, combined with the cost of transportation to the end-user or processing site, adds cost to the final product. Increasing vehicle fuel costs have exacerbated the transportation component.

Photo: Dan Bihn

- ***Low-Value Material***—Much of the material being considered for biomass utilization and bioenergy projects is in the small-diameter range and includes material usually considered a waste or residue of thinning and fuels reduction work. Traditionally chipped into the forest, masticated on site or piled and burned, such material is now being considered for utilization.

Key Issues

- ***Scale***—The creation of biomass markets and the utilization of material generated from forest restoration and fuels reduction projects must match the long-term sustainability of the resource base. It will be imperative to monitor the utilization projects coming on line to ensure the principles of sustainability are met.
- ***Sustainability***—Many factors go into this complex issue. In addition to the biological factors involving how much is growing in the areas where fuel reduction and forest restoration work is occurring and when these areas will be ready for another management entry (20 to 40 years), there are issues related to funding, potential wildfires or insect/disease events, supply and demand for biomass material for other uses and general public attitudes toward forest management activities.
- ***Economics***—Unless the use of woody biomass is economical at all phases in the utilization chain, conversion to technologies using the material will be hampered. Some uses—facility heating, for instance, may require small subsidies to move market development forward.
- ***Education***—There is a general perception the use of woody biomass is a "dirty industry." Education will be a key component to show that facility heating projects and other efforts involving woody biomass—such as co-firing with coal, gasification, etc.—is clean and does meet today's environmental regulations.

Glossary of Terms

Bone Dry Ton—Unit of measure used by pulp, paper and biomass industries that utilize biomass (primarily in chip form) as its raw material. One BDT is 2000 pounds at zero percent moisture. Many times, biomass, when processed in the forest, is delivered green to the end-use facility at 50% moisture.

Renewable Energy Credits—Sometimes known as RECs, green tags, green energy certificates or tradable renewable certificates, they represent the technology and environmental attributes of electricity generated from renewable sources.

Gasification—The thermochemical conversion of organic solids and liquids into a producer, or synthetic, gas (syngas) under very controlled conditions of heat and oxygen. ***Gasifier***—A combustion device that produces biogas from solid biomass.

Cogeneration—The combined generation of both heat and power at one facility using the same fuel source. Also referred to as combined heat and power (CHP)

Carbon Sequestration—CS refers to the provision or ability long-term storage of carbon in the terrestrial biosphere, underground or in the oceans so the buildup of CO2 (the principal greenhouse gas) concentration in the atmosphere will reduce or slow. In some cases this is accomplished by maintaining or enhancing natural processes. For woody biomass, this relates to improving forest growth and overall forest health. For more go to:
http://www.netl.doe.gov/technologies/carbon_seq/index.html

Conversion Factors

Biomass Production

- Thinning for fuels reduction/restoration purposes can yield 10 to 40 tons per acre. If higher value products (logs, post and poles, etc.) are removed and marketed, this will generally yield 10 to 20 tons per acre of small diameter material and associated residue available for biomass utilization.
- Approximately 3 to 5 cu. yds. of chipped or ground material weighs 1 ton (of green material)
- Sites in Colorado can produce a range of growth in terms of biomass yield but is in the range of 30 to 70 cu. ft. per acre per year. This varies in relationship to elevation, soil type/productivity, moisture, and species.

Biomass for Energy

- 1 Green Ton (GT) = 2000 lbs. (not adjusted for moisture;
  1 Bone Dry Ton (BDT) = 2000 lbs. (assumes no moisture)
- 1 Bone Dry Ton of chips = 2 Green Tons (assuming 50% moisture)
- 1 CCF of roundwood = 1.2 Bone Dry Ton of chips
- 1 cord (cd) wood = 85 cu. ft. biomass;
  1 cd. (green material) = 1.5 tons = 5–6 cu. yds.
- 1 Megawatt (MW) = 1000 Horsepower;
  1 MW can power 750–1,000 homes

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Conversion Factors (cont.)

Biomass for Energy

- 1 KWh = 3413 BTU; 1 BTU = 0.000293 KWH; 1 therm = 100,000 BTU; 1 lb. of wood can produce 850 BTU's of heat

Ongoing Efforts and Projects

For the latest updates on ongoing biomass utilization projects in Colorado, visit one of the following web sites:

- www.coloradobiomass.org
- http://www.colorado.gov/oemc/
- http://www.fs.fed.us/forestmanagement/WoodyBiomassUtilization/index.shtml

Resources

Web Sites

Technical

www.fs.fed.us/forestmanagement/WoodyBiomassUtilization/index.shtml
www.fpl.fs.fed.us/tmu
contacts@biomasscenter.org
www.colostate.edu/programs/cowood

Ecological

www.frftp.org/
http://www.fs.fed.us/rm/

Business Assistance

http://www.advancecolorado.com/index.cfm
www.rurdev.usda.gov/co/index.html
www.colostate.edu/programs/cowood
http://www.gwedap.org/

Photo: Dan Blhn

Reports

Billion Ton Report

www.colorado.gov/oemc/programs/waste/biomass/resources/Billion-Ton_Vision.pdf

WGA Biomass Task Force Report

www.westgov.org/wga/initiatives/cdeac/Biomass-full.pdf

Western States Biomass Assessment

http://www.fs.fed.us/research/pdf/Western_final.pdf

Front Range Opportunities Report

www.colorado.gov/oemc/programs/waste/biomass/resources/Front_Range_Biomass_Opportunities.pdf

GAO Report: Woody Biomass Users' Experiences Offer Insights Aimed at Promoting Its Use

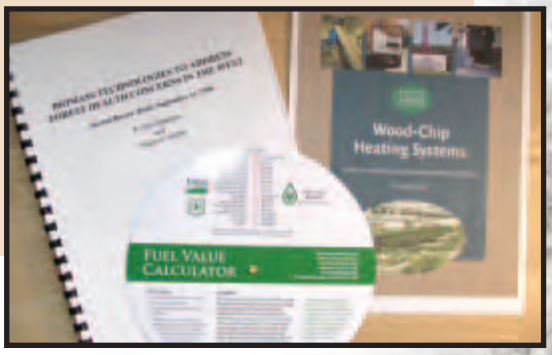
http://www.gao.gov/new.items/d06336.pdf

Other Resources/Grants

http://www1.eere.energy.gov/biomass/

cpgrants@usda.gov

www.sba.gov/sbdc



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This brochure was prepared by the Colorado Governor's Office of Energy Management and Conservation in collaboration with the partners of the Colorado Biomass Working Group.